Switching off? Challenges in engaging students in energy efficiency. Findings from an EU wide energy saving project

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Abstract

The success of projects encouraging pro-environmental behaviour change amongst students in university accommodation has been well documented but typically focuses on small-scale interventions – whether geographically or temporally. This paper presents findings from an EU funded international competition, which discusses insights on a scale previously unseen. SAVES is an inter-dormitory energy-saving competition that is being run in five countries and has reached over 50,000 students over the last two years specifically, over 480 dormitories at 17 Universities. Building on the successful UK 'Student Switch Off' (SSO) competition run by the National Union of Students, SAVES provides engagement with students, enabling, empowering and motivating them to save energy – focusing specifically on the last stage of the 'Awareness, Interest, Desire, Action' framework. Smart meter data is used to run real-time energy challenges through an energy dashboard that informs students how much energy they are using, and encourage peer-to-peer learning and international cooperation through a virtual twinning scheme. This paper presents findings on the effectiveness of Student Switch Off competition, as it has been implemented in Europe. A mixed methods approach (pre- and post- intervention surveys, focus groups and analysis of energy meter data) was taken to evaluate the level of energy savings and quantifiable behaviour change delivered in students across participating dormitories and countries. Reflections and recommendations are offered towards the role of student-led competitions and energy dashboards as a method for communicating data to students.

Introduction

Much has been written about the need to reduce energy consumption in buildings and this is unsurprising given their environmental impact. In terms of their energy consumption, non-domestic and commercial buildings account for over 30 % of global energy use and 20 % of greenhouse gas emissions (Andrews and Johnson 2016; Stern et al. 2016). Universities present a complex proposition as they have a significant carbon footprint split across their direct and indirect emissions. In terms of their business operation and staff they encompass traits of non-domestic organisations, and yet, through the provision of student accommodation, they often exhibit traits of residential properties. Alberts et al. (2016), for example, locate their research into electricity consumption in University dormitories within the domestic energy consumption literature.

A range of literature exists on behaviour change interventions aimed at encouraging university students to save energy when living in halls of residence and on the relative impact of different types of interventions (e.g. Karp et al. 2016; Sintov et al. 2016). Such studies have often focussed on interventions in one geographic location (typically a number of dormitories/flats in one university) or over a relatively short timescale (a week/month). This paper focuses on the impact of an energy-saving competition, peer-to-peer engagement and feedback across a range of universities over two academic years. It presents findings from an EU Intelligent Energy Europe (IEE) project SAVES (Students Achieving Valuable Energy-Savings)

which encompasses an inter-dormitory energy-saving competition that ran in over 480 dormitories in 17 Universities in the 2014/15 and 2015/16 academic years. At the heart of the SAVES project is an energy-saving competition called Student Switch Off. The Student Switch Off (SSO) campaign was set up by the National Union of Students (NUS) in 2006 and encourages students to pledge to save energy and encourage their flatmates to do the same. Over the academic year the SSO incorporates a variety of offline and online events and competitions to keep awareness as high as possible and distributes prizes at the individual level to keep pro-active students motivated. These include fortnightly photo competitions themed around different energy-saving actions where students post photos on the SSO Facebook fanpage of their university to win prizes; dormitory visits; communication skills training (to give proactive students more expertise to encourage their friends to save energy) and online climate change quizzes. Prior to SAVES starting, in 2012/13 Student Switch Off was delivered at 54 UK universities, reached 130,000 students, engaged 25,000 through Facebook fanpages, pledge schemes and events delivered average energy-savings of 6 % per participating dormitory.

Unlike previous SSO competitions where the energy-savings were presented every 1–2 months after manual energy data analysis had been completed, SAVES utilized digital communications to raise awareness of how students can save energy, and notably, test the use of smart meter data to run real-time energy challenges, inform students about how much energy they are using, and encourage peer to peer learning and international cooperation through a virtual twinning scheme. SAVES had two aims; one was to generate an average of 8 % of electricity savings in participating dormitories and two, to install energy-saving habits in students at a key moment of change in their lives so that when students move out of dormitories into private accommodation, they carry forward the energy-saving actions. To do this the project focused on the following behaviours:

- Switching off lights
- Switching off appliances when not in use
- Putting lids on pans when cooking
- Putting jumpers on instead of turning up the heating
- Not overfilling the kettle
- Opening windows before using air conditioning (relevant in the hot EU countries).

There have been several studies focusing on universities and in particular student halls of residence, which have consistently shown relatively high savings. From the classic study in Oberlin in 2007 (Peterson et al. 2007) which saw 30 % savings, to more recent campaigns in British Columbia (Senbel et al. 2014) – 16 % savings - and London (Alberts et al. 2016) – 20 % savings), healthy savings are possible, yet all of these studies focus on single Universities, and were conducted over short periods of time. The benefits of peer-to-peer engagement were observed by Senbel et al. (2014) in their research in six Universities in British Columbia. Whilst it was found that the competition generated savings, people were motivated by the actions of people known to them, rather than strangers. The benefits of competitions are also seen by Alberts et al. (2016) and we confirm their observations though do question their framing of their study as 'residential'. The Oberlin study (Peterson et al. 2007) itself identified the need for a 'broader scale, longer term study'. This project (SAVES) focused on students as a distinct group of consumers, many of whom will be living away from home for the first time and adopting new energy-usage habits. Theoretical underpinnings come from the habit discontinuity hypothesis of Verplanken and Wood (2006) who suggest that when individuals undergo significant change in their lives (e.g. having a baby, moving home) they may be more amenable to adopting new, pro-environmental behaviours. This is because the habit cues that previously prompted certain behaviours have been altered and individuals are more likely to consciously consider the actions they undertake (Wood and Neal, 2009). This also backs up observations from Peterson et al. (2007) who discovered that 'freshmen' – those new to University – were more open than students who had been there longer. For the majority of students moving to university, this is the first time they have experienced independent living – a significant lifestyle change, during which they have the potential to adopt new pro-environmental habits.

Whether the context is domestic or commercial though, the invisibility of energy has become a common theme with a rich debate emerging over the last decade exploring both the role of energy dashboards and the limits of feedback (Burgess and Nye 2008). Findings have shown that whilst feedback does offer potential for reducing consumption, between 5–15 % on average (Burgess and Nye 2008), there is no simple cause and effect between installing new forms of domestic energy metering and subsequent behaviour change by the householders.

Energy feedback within organisational contexts more widely has seen mixed results and come under some criticism for both relying on an information deficit approach to behaviour change, and failing to appreciate the wider institutional complexities of behaviour change in organisations (Bull et al. 2015). Acknowledging that the academic critiques of the limits of feedback may be justified, a recent review of the literature and evaluation of an energy savings intervention in a commercial office space by Mulville et al. (2016) achieved healthy savings of 18 % over the intervention period. Elsewhere though, after conducting their research into providing individual energy feedback to University employees, Murtagh et al. (2013) offered a sobering reflection for behaviour change noting that whilst the potential for significant savings are high, motivation is low.

The next sections describe the research methodology and then the research findings in terms of both behaviour change and energy savings. The energy dashboard use is also described below.

Methodology

As stated in the introduction, the contribution of this paper is the scale of data gathered in order to be able to generate findings with regards to the effectiveness of these types of interventions. A mixed-methods approach was utilised in order to evaluate the level of electricity saved and the impact on behaviour. Behaviour swings are indicative of the impact that the SSO campaign has had on students and that has led to the reported energy savings.

THE SAMPLING FRAME

The sampling frame for the calculation of energy savings consisted of dormitory buildings used as university student accommodation in five different European countries: Cyprus, Greece, Lithuania, Sweden and the UK. The sampling frame for the evaluation of behaviour swings consisted of students living in the participating dormitory buildings. The setting up of a control group was not initially planned but it was later decided that it could bring added value to the assessment of the impact of SSO. A control building (control group) was identified in Sweden (in Linkoping) where a building with a large number of residents and accessible baseline and contemporary energy data was readily available at the time that the study was initiated. This building in Sweden was also chosen, as there were no other behavioural interventions taking place – unlike many potential UK universities that have other related activities that could interfere with the control. Residents of the control group dormitory buildings also took part in the pre- and post-competition questionnaire surveys. In total this amounted to 17 different university housing providers, housing 24,976 students over the academic year 2014/15 and 30,349 students in 2015/16 (55,325 students in total over two years). The sample of control group students was 2,406 each year.

DATA COLLECTION

Baseline electricity data was collected for each of the participating dormitory buildings for the 2013–2014 academic year in the majority of cases; in dormitory providers where SSO was run in years prior to 2014–15, the baseline was formed from the year prior to the campaign starting. The baseline electricity data was collected through historical meter readings. The electricity data for the years that SSO ran were collected with the help of smart meters installed in the majority of cases. Where dormitories were electrically heated or cooled, degree-day analysis was performed to ensure fair comparison. In a small number of cases where data for a month was missing or erroneous, it was extrapolated based on the average of the data available for other months. For the majority of dormitory providers eight months' worth of data was compared, in a few dormitories nine months' worth of data was used. In 2015–16 energy savings were fed back through the energy dashboard developed by De Montfort University; this was only used at one participating dormitory provider in 2014–15.

The baseline and follow-up surveys used for the evaluation of behaviour swings were circulated online and were incentivised; a €100 1st cash prize, and 3 × €25 were offered as project-wide incentives for both the baseline and follow-up surveys, while country specific incentives (i.e. additional cash draw or chocolate) were provided only for the baseline survey. Behaviour change, and energy-savings, were studied for both academic years that the SSO campaign was run – 2014–2015 and 2015–2016. All students in participating dormitories, including the control group in Sweden, were encouraged to complete the survey at the start of the academic year (pre-intervention) and closer to the end of the academic year (post-intervention). Only students that responded to the baseline survey could participate in the follow-up survey in order to be eligible for the pre- post- comparison evaluation. The survey was circulated in all the participating dormitories. The survey included questions covering a number of topics including: demographics, psychological, social and behavioural aspects, incentives and barriers for energy saving. In all countries except for the UK 60 % or more of respondents lived in dorms of the same dorm provider in both years. In the UK this percentage was only 7 % because the vast majority of students move out into the private-rented sector each year. The specificities of returning students have not yet been studied.

A questionnaire survey was also conducted with students who lived in participating dormitories in 2014/15 but moved into private accommodation in 2015/2016. The aim of this survey was to help identify whether the energy-saving actions established during their time in dormitories had been carried forward. The survey was sent to all students that responded to the follow-up survey the previous academic year. A question asking the respondents if they are living in private accommodation or in dorms was used to screen out the students that still lived in dorms. It had 2 × €25 cash prizes associated to it as project-wide incentives for participation. Overall, 98 valid responses were collected and included representation from all five participating countries.

DATA ANALYSIS

Analysis was performed at project level, country level, and at dormitory level. Throughout 2014–15 and 2015–16 data was collected for each of the participating dormitories and compared to the baseline data to find out how much energy was saved by students through their behavioural changes. Descriptive statistics were used to describe the basic attributes of the sample at the project and at country/group level. A Chi-squared test was used to determine any significant differences between countries and between the treatment and control group. A paired sample t-test was used as a pre-intervention to post-intervention comparison test to determine significant changes between the baseline and follow-up survey. The findings of the analysis on the targeted energy saving behaviours are presented in this paper.

RESPONSE RATE

The total number of responses for the follow-up survey was 1,541. From those 1,541 respondents, 1,358 were matched to respondents of the baseline survey and were therefore considered for the pre- to post-comparison test. All countries apart from Greece and Cyprus had a large number of respondents. In Cyprus the number of students living in dorms was 208 and 29 were matched with the baseline survey over the two years. In Greece although the number of students living in the dormitories that implemented Student Switch Off was higher (1,142 students) the lack of a mailing list limited the number of students that could be reached. The number of matched respondents in Greece was 35 over the two years. The end result though, of both the metered energy data and the survey, has been a far-reaching Europe-wide data set which is explored in the following results section.

ENERGY DASHBOARD

The dashboard (https://switchoff.nus.org.uk) functioned as a web application designed to receive files generated by energy management systems containing energy consumption data and enabling universities to create competitions where data is represented as 'league tables' that are automatically updated as new

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data is uploaded (manually or automatically). As a 'responsive web-app' it was easily viewable on mobile, tablet and desktop devices and was also embedded in SSO University Facebook pages to increase their visibility. Towards the end of the second year two focus groups were held in the UK and Cyprus to gain feedback from students on the design and use of the dashboard.

Results

BEHAVIOUR CHANGE

The findings of the questionnaire survey analysis are indicative of the impact that the SSO campaign has had on students and that has led to the reported energy savings. The findings of the survey relevant to the scope of this paper are presented in this section. Respondents were asked to rate the increase in the level of awareness on what they can do to reduce the impact of their lifestyle and habits on energy consumption on a 1 to 5 scale (1 = A great deal, 5 = Not at all). The lower the mean value the greater the increase in energy awareness. Overall, students felt that their energy awareness had increased by a little at the end of the academic year compared to the beginning of the academic year in both years that the study was performed. The biggest increase of energy awareness was found in Cyprus and Greece in both years. In Greece and Cyprus, the biggest change between the two years is also found. This is attributed to the fact that the sample size for those two countries was small and therefore more sensitive to change.

Respondents were also given a list of sources of information and were asked to select those that may have helped increase their energy awareness. Only the respondents that answered 1 = A great deal, 2 = A fair amount and 3 = A little in the previous question were given the option to answer this question. The three sources of information that helped the most in the increase of students' energy awareness were: the Student Switch Off campaign, family and an article they had read or a documentary they watched. Student Switch Off was in the top three most influential sources of information in all five countries in both academic years that the study was performed. The least influential sources of information were: feedback and information on their dormitory's energy consumption, university courses and friends living in their dormitory. These sources of information were the least important sources in both academic years.

The frequency that each of the six target energy-saving behaviours were undertaken was measured on a five-point scale with values ranging from 1 = Never to 5 = Always. The higher the mean value, the greater the habit strength. The percentage change in the mean values between the beginning and the end of each academic year for each behaviour targeted by SSO is presented in Table 1 and Table 2. A positive percentage change indicates an increase in the frequency that an expressed behaviour is performed at the end of the academic year compared to the beginning of the academic year, A negative percentage change indicates a decrease in the frequency that a stated behaviour is performed at the end of the academic year, It should be noted that for the first year of the campaign results for Lithuania are not available due to the accidental deletion of this question from the Lithuanian version of the baseline survey.

Out of the six targeted energy saving actions a statistically significant increase is observed in the frequency that the less well-known energy saving actions are performed, namely putting a lid on pans when cooking and boiling only the right amount of water in both years. In the first year of the project a somewhat significant increase is observed in the frequency that electronic appliances are turned off as well. In Cyprus, a significant positive increase is found in switching off lights the first year and in putting a lid on pans the second year of the campaign. In Greece, a significant positive change is found in putting a lid on pans the first year and in boiling only the right amount of water in the kettle the second year. In Lithuania, no significant positive change is observed. In Sweden, a significant positive change is found in putting a lid on pans, boiling only the right amount of water and putting an extra layer on instead of the heating in the first of the campaign. In the second year a significant positive change is only found in putting lid on pans. In the UK, a significant positive change is only found the second year of the campaign for boiling the right amount of water. In the control group smaller or equal change, compared to the treatment group, is observed in all targeted behaviours in both years.

On retention of behaviours, 68 % of the respondents no longer living in dorms said that when living in dorms the aware-

Table 1. Targeted behaviours' swings across the EU countries (2014–2015).

Action	Cyprus	Greece	Sweden	UK	Total	Control group
Switch off lights in empty rooms	*6 %	3 %	-1 %	0 %	0 %	*-3 %
Avoid leaving electronic equipment on stand-by	11 %	0 %	4 %	3 %	**4 %	-1 %
Put a lid on pans when cooking	-2 %	*18 %	*6 %	1 %	**3 %	2 %
Boil the kettle only with the amount of water you intend to use	2 %	8 %	**5 %	2 %	*4 %	*5 %
Put an extra layer on before deciding to turn on the heating	-2 %	-2 %	**6 %	-2 %	1 %	1 %
Open windows before deciding to use a cooling device or system	9 %	0 %	-1 %	1 %	1 %	-1 %

** Statistically significant, p<.05.*

*** Somewhat statistically significant, 0.5<p<07.*

Table 2. Targeted behaviours' swings across the EU countries (2015–2016).

Action	Cyprus	Greece	Lithuania	Sweden	UK	Total	Control group
Switch off lights in empty rooms	-2 %	0 %	-4 %	0 %	0 %	-1 %	*-4 %
Avoid leaving electronic equipment on stand-by	6 %	7 %	-2 %	-3 %	-1 %	-2 %	-4 %
Put a lid on pans when cooking	*16 %	9 %	0 %	*5 %	3 %	*4 %	0 %
Boil the kettle only with the amount of water you intend to use	14 %	*17 %	*-8 %	3 %	*6 %	**3 %	1 %
Put an extra layer on before deciding to turn on the heating	-4 %	*-15 %	-3 %	-1 %	1 %	0 %	-3 %
Open windows before deciding to use a cooling device or system	-2 %	6 %	1 %	-1 %	0 %	0 %	-2 %

** Statistically significant, p<.05.*

*** Somewhat statistically significant, 0.5<p<07.*

ness on how to save energy increased as a result of information/posters/messages students received from the Student Switch Off campaign. Seventy per cent of those respondents took action to save energy as a result of the SSO campaign the previous academic year. From the 70 % of respondents that took action to save energy as a result of the SSO campaign last academic year almost all of them (99 % of them) continued to take those actions in their current life when living outside of halls. The majority of respondents (74 % of respondents) continued to take energy saving actions in their current lives to save money. A large number of respondents also continued to take the energy saving actions because they had gotten into the habit of saving energy (56 % of respondents) and to take personal action on climate change (48 % of respondents). Encouragement from flatmates and saving time were not popular reasons for taking energy saving actions (3 % and 6 % of respondents, respectively).

ENERGY SAVINGS

An important measure of the project's success was quantifiable energy saving. As noted earlier, previous studies have shown savings ranging from 16 % to 30 %, but over relatively short periods. The Senbel et al. (2014) study also saw the 16 % saving during the campaign fall to 6.7 % 5 months after campaign. For our study, electricity data was collected throughout the project from participating dormitories and compared against baseline data (pre-intervention); it was a prerequisite that dormitory providers had at least one year's worth of electricity data prior to the SSO campaign starting, to form the baseline. In the academic year 2014–15 1,5 million kWhs of electricity were saved (5.26 %), whereas in 2015–16 there was a saving of 2.5 million kWhs (8.76 %). The reason for this was most likely a combination of the improvements made by delivery partners between the two years of the project in the light of lessons learned (feedback surveys, focus groups, and trial and error) and the addition of the dashboard –it is, however, impossible to disaggregate the exact impact of different changes on overall savings between the two years. Energy data was also compared against the control group set up in Linkoping, Sweden. In both the academic years there was a significantly higher saving in the treatment group in Sweden compared to the control group. In 2014–15 there was a 12.06 % saving in the treatment group compared to 2.81 % in the control group, whereas in 2015–16 these figures were 12.18 % and 1.99 % respectively.

ENERGY DASHBOARD USE

One of the key features of year two of the SAVES project and the student engagement was the energy dashboard designed by De Montfort University (DMU) in conjunction with feedback from two focus groups in Bath and Cyprus. The dashboard communicated the energy savings of the SSO competition via an on-line platform that allowed student to regularly view the energy savings of their halls. This in contrast to previous SSO competitions whereby students only found out who has saved the most energy at the end of the competition and this was frequently identified in focus groups and surveys as a barrier to energy saving. This energy dashboard allowed students to view progress on a monthly, weekly or daily rate – depending on the granularity of the energy data being uploaded to the dashboard.

The focus group in the University of Bath was really well attended with 12 participants although it was found that there was limited use of the dashboard. This lack of engagement was attributed to the local ambassadors and residence coordinators not promoting this aspect of the competition. When shown the energy dashboard though the focus group was positive about its appearance and functionality, for example one student said, "if I had known about I definitely would have looked at it". The most noticeable 'negative' comment was around the international competition. No-one saw any great benefit in having their hall compared to an international one. For example, student said "What is the point in comparing consumption with a country you don't know?" and "It'd be better if we being compared with Universities near us". The value in league table was being compared to their local halls, and perhaps national ones. Constructive comments were made regarding the need for consumption data, energy saving tips and email alerts to look at the dashboard. In summary then, students liked the idea of the dashboard but would have liked it to be easier to access (via email alerts for example), and would like more relevant information from it both in terms of who they were being

compared to, how much energy they were consuming and what they could do about it.

At the University of Cyprus the focus group had 5 attendees. They all seemed to agree that the dashboard is a very useful tool. The dashboard informed them of their energy consumption and they liked its appearance and its colour scheme. In common with wider research on dashboards, one student said that "initially I was very excited by the dashboard and I was accessing it, at least once a week. As the time passed this excitement started fading away and I stopped accessing it so frequently. Now that the competition is over, I don't use it at all." Most students particularly liked the ranking and the percentage change. Almost all of the students accessed the dashboard from a PC or laptop, through the local competition Facebook page. Across the two focus groups the common feedback for the future of the dashboard was that they preferred comparisons to be with 'halls' near them, they wanted increased social media functionality, regular alerts and discussion forums coupled with greater interactivity.

Conclusions

This paper has provided further insight into the potential for savings and behaviour change in University halls of residences through relatively simple actions. Whilst other interventions have shown greater savings, this two-year project across five countries has provided consistent savings of 7 % across a large number of universities through simple behaviour change actions over the two year period. Further research is required to understand the potential of dashboards to contribute to these savings and in constructing competitions between people and halls that are known to each other. This echoes the findings of Senbel et al. (2014) who found people engage better with those whom they know. The literature does seem to show that after an initial impact the role of dashboards is limited. The data is not here to substantiate or contradict that view. That said, students are optimistic about the role the dashboards can play, particularly in contributing to the competitive element of the programme. In the context of students in halls of residences, we would argue that a lack of agency and control over many aspects of energy, and the lack of being responsible for the bill itself, aligns more to organisational studies than residential. Furthermore, the habit discontinuity theory shows promise as the change in lifestyles that students encounter leads them open to change at this time of life and offer hope for the future inasmuch these habits are likely to continue in later life.

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